HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Minter Creek/Coulter Creek Coho Program
Species or Hatchery Stock:	Coho (*Onchorhynchus kisutch*) Minter Creek/Coulter Creek
Agency/Operator:	Washington Department of Fish and Wildlife
Watershed and Region:	Minter Creek, Puget Sound Coulter Creek, Puget Sound
Date Submitted:	March 17, 2003
Date Last Updated:	January 15, 2003

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Minter Creek/Coulter Creek Coho Program

1.2) Species and population (or stock) under propagation, and ESA status.

Minter Creek/Coulter Coho (*Onchorynchus kisutch*) - not listed

1.3) Responsible organization and individuals

Name (and title):	Ron Warren, Region 6 Fish Program Manager Denis Popochock, Complex Manager	
Agency or Tribe:	Washington Department of Fish and Wildlife	
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Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

Suquamish Tribe (Agate Pass Net Pens), Nisqually Tribe (Clear Cr. Hatchery) and educational and volunteer co-ops.

1.4) Funding source, staffing level, and annual hatchery program operational costs.

This program is funded through the State General Fund.

1.5) Location(s) of hatchery and associated facilities.

Minter Creek Hatchery:	Located on Minter Creek (15.0048) at RM 0.5. Minter Creek is a tributary to Carr Inlet in Puget Sound.
Coulter Creek Hatchery:	Located at RM 0.25 on Coulter Creek (15.0002), tributary to Case Inlet on Puget Sound, Washington.

1.6) Type of program.

Isolated harvest

1.7) Purpose (Goal) of program.

Augmentation.

The goal of this program is to provide adult fish for harvest opportunity.

1.8) Justification for the program.

This program will be operated to provide fish for harvest while minimizing adverse effects on listed fish. This will be accomplished in the following manner:

1. Release coho as smolts with expected brief freshwater residence.

2. Time of release not to coincide with out-migration of listed fish.

3. Only appropriate stock will be propagated.

4. Mark all reared fish.

5. Hatchery fish will be propagated using appropriate fish culture methods and consistent with Co-Managers Fish Health Policy and state and federal water quality standards; e.g.NPDES criteria.

1.9) List of program "Performance Standards".

See section 1.10.

1.10) List of program "Performance Indicators".

Performance Standards and Indicators for Puget Sound **Isolated Harvest** Coho programs.

Performance Standard	Performance Indicator	Monitoring and Evaluation Plan
Produce adult fish for harvest	Survival and contribution rates	Monitor catch and cwt data
Meet hatchery production goals	Number of juvenile fish released - **1,044,000**	Future Brood Document (FBD) and hatchery records
Manage for adequate escapement where applicable	Hatchery return rates	Hatchery return records

Minimize interactions with listed fish through proper broodstock management and mass marking. Maximize hatchery adult capture effectiveness. Use only hatchery fish	Number of broodstock collected - **4,500**	Rack counts and CWT data
	Stray Rates	Spawning guidelines
	Sex ratios	
	Age structure	Hatchery records
	Timing of adult collection/spawning - **October to December**	Spawning guidelines Hatchery records
	Adherence to spawning guidelines - **see section 8.3**	
	Total number of wild adults passed upstream - **out of approx. 1,000 fish passed upstream 60% are wild adult coho**	
Minimize interactions with listed fish through proper rearing and release strategies	Juveniles released as smolts	FBD and hatchery records
	Out-migration timing of listed fish / hatchery fish - **April-May /April-May**	FBD and historic natural outmigration times
	Size and time of release - **17 fpp/April-May release**	FBD and hatchery records
	Hatchery stray rates	CWT data, mark/unmark ratios
Maintain stock integrity and genetic diversity	Effective population size	Spawning guidelines
	Hatchery-Origin Recruit spawners	

Maximize in-hatchery survival of broodstock and their progeny; and Limit the impact of pathogens associated with hatchery stocks, on listed fish	Fish pathologists will monitor the health of hatchery stocks on a monthly basis and recommend preventative actions / strategies to maintain fish health	Co-Managers Disease Policy
	Fish pathologists will diagnose fish health problems and minimize their impact	Fish Health Monitoring Records
	Vaccines will be administered when appropriate to protect fish health	
	A fish health database will be maintained to identify trends in fish health and disease and implement fish health management plans based on findings	
	Fish health staff will present workshops on fish health issues to provide continuing education to hatchery staff.	
Ensure hatchery operations comply with state and federal water quality standards through proper environmental monitoring	NPDES compliance	Monthly NPDES reports

1.11) Expected size of program.

1.11.1) Proposed annual broodstock collection level (maximum number of adult fish).

4,500 for the hatchery program plus an upstream escapement goal of approximately 1,000 fish of hatchery and wild origin (see research section 12).

1.11.2) Proposed annual fish release levels (maximum number) by life stage and location.

Life Stage	Release Location	Annual Release Level
Eyed Eggs		
Unfed Fry		
Fry		
Fingerling		
Yearling	Minter Creek (15.0048)	*1,044,000

*- Since 1995 BY, program has been reduced from a release of 1,500,000 to the present release of 1,044,000.

**-1,000,000 egg are transferred to the Nisqually tribal hatchery at Clear Creek for rearing and release.

***-420,000 are transferred to the Agate Pass Sea Pens (Suquamish tribe) via Coulter Creek for rearing and release.

****-In addition to the yearling coho program, the hatchery transfers coho eggs to schools and eggs to Regional Enhancement Groups and other co-ops for releases into various streams in South Puget Sound.

*****-Provides fish for the South Sound Net Pen program (WDFW, Squaxin Tribe) release.

1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.

No station production has been coded-wire tagged since 1983. The escapement levels back to the hatchery from 1995 through 2001 have been 12,295, 16,389, 19,998, 9,391, 2,889, 15,490 and 16,858, respectively.

1.13) Date program started (years in operation), or is expected to start.

Minter Creek started in 1936 and Coulter Creek coho program started in 1980.

1.14) Expected duration of program.

Ongoing.

1.15) Watersheds targeted by program.

Minter Creek (15.0048)

1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.

None.

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS.

2.1) List all ESA permits or authorizations in hand for the hatchery program.

None.

2.2) Provide descriptions, status, and projected take actions and levels for ESA-listed natural populations in the target area.

2.2.1) Description of ESA-listed salmonid population(s) affected by the program.

There are no ESA-listed natural salmonid populations in the program target area. Salo and Bayliff (1958) indicated that there was not an indigenous fall chinook stock in Minter Creek. In this watershed, adult chinook returns and any resulting natural production are dependent upon local hatchery program production. The available habitat is not judged to be typical, productive fall chinook habitat and would not likely support a self-sustaining, naturally spawning fall chinook population. If the local hatchery production program was terminated, it is expected that natural chinook production in this watershed would eventually disappear. These opinions could be tested by identifying all hatchery fall chinook production in this watershed and monitoring natural production /productivity.

- Identify the ESA-listed population(s) that will be directly affected by the program.

- Identify the ESA-listed population(s) that may be incidentally affected by the program.

South Sound Tributary Summer/Fall Chinook. Stock-specific spawning ground, juvenile life history, survival and productivity data are generally lacking for this natural population. The population is presumed to be similar in biological characteristics to the other south Puget Sound fall chinook populations (Puyallup River and Green River fall chinook), since it is thought to be dependent on ongoing hatchery production (strays) in south Puget Sound. SASSI defines this stock as naturally spawning chinook in a number of widely distributed rivers, including McAllister Creek, Grovers Creek, Gorst Creek, Chambers Creek, Carr Inlet tributaries, the Deschutes River and other small streams in south Puget Sound.

White River Spring Chinook (WRSC). There is a hatchery supplementation program for this stock at the Hupp Springs rearing facility in the Minter Creek watershed. This program is independent of the White River natural population, utilizing on-station returns to the Minter Creek trap for broodstock and releasing 90,000 yearlings and 250,000 fingerlings into Minter Creek each year. Excess production is transferred to the White River.

2.2.2) <u>Status of ESA-listed salmonid population(s) affected by the program.</u>

- Describe the status of the listed natural population(s) relative to "critical" and "viable" population thresholds

Critical and viable population thresholds under ESA have not been determined, however, the SASSI report determined that status of the South Sound Tributary Summer/Fall Chinook stock is "healthy" and White River Spring Chinook (WRSC) as "critical".

- Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.

Not known

- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

White River Spring Chinook Average Annual Returns, 1992 to 1999: 462 (range 316-604)

Estimates of fall chinook spawning naturally in South Sound Tributaries:

Year	Spawning numbers
1988	4257
1989	4979
1990	15814
1991	3681
1992	3610
1993	2998
1994	4950
1995	7456
1996	14931
1997	4192
1998	6372
1999	11028

- Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

South Sound Tributary Summer/Fall Chinook- Unknown. We do not have spawning ground data to estimate the proportion of origin of the spawners in South Sound independent tributaries.

White River Spring Chinook-Unknown. These escapements are likely predominantly hatchery-origin fall chinook because of low escapements passed above the rack and expected low natural chinook productivity in this watershed.

2.2.3) <u>Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of listed fish in the target area, and provide estimated annual levels of take</u>

- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.

The release of fish as described in this HGMP could potentially result in ecological interactions with listed species. These potential ecological interactions are discussed in Section 3.5, and risk control measures are discussed in Section 10.11. Implementation of the program modifications provided in this HGMP, and the actions previously taken by the comanagers, are anticipated to contribute to the continued improvement in the abundance of listed salmonids.

- Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.

Unknown

-Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).

See "take" table at the end of this HGMP

- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. *Hood Canal Summer Chum Conservation Initiative*) or other regionally accepted policies (e.g. the NPPC *Annual Production Review* Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

There are no applicable plans or policies.

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.

This program operates consistent with the Puget Sound Salmon Management Plan.

3.3) Relationship to harvest objectives.

3.3.1) Describe fisheries benefitting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.

The following mean contribution rates, by fishery, for Minter Creek coho production are based on 19 coded-wire-tagged releases of 1977 through 1983 brood production.

Minter Creek yearling coho releases:

Fishery	Mean Contribution Rate (Catch/yearling released)
Alaskan Fisheries	0.00000
Canadian Fisheries	0.01741
Oregon Fisheries	0.00157
WA Treaty Troll	0.00080
WA Non-treaty Troll	0.00346
WA Ocean Sport	0.00565
PS Net	0.03343
PS Sport	0.01054
Freshwater Sport	0.00000
Total Fishery Contribution	0.07286

This mean contribution rate would estimate a total fishery contribution of 105,210 fish from the current programmed release of 1,044,000 yearlings. The mean harvest rates for these coded-wire-tag releases was 82.4% for all fisheries and 59.3% for Washington fisheries, alone.

The above mean contribution and harvest rates are likely not representative of current rates. There has been a significant reduction in South Sound coho marine survival rates, however, there is only one coded-wire-tagged Minter Creek release group available to represent recent survival and fishery management scenarios. The following rates provide, at least, a sense of the magnitude of that survival shift and the resulting changes in fishery contribution.

The following contribution rates, by fishery, for Minter Creek coho production are based on one coded-wire-tagged release of 1994 brood production.

Minter Creek coho yearling releases:

Fishery	Mean Contribution Rate (Catch/yearling release)
Alaskan Fisheries	0.00000
Canadian Fisheries	0.00000
Oregon Fisheries	0.00000
WA Treaty Troll	0.00000
WA Non-treaty Troll	0.00000
WA Ocean Sport	0.00034
PS Net	0.00034
PS Sport	0.00154
Freshwater Sport	0.00000
Total Fishery Contribution	0.00222

This contribution rate would estimate a total fishery contribution of 3,206 fish from the current programmed release of 1,044,000 yearlings. The harvest rate for this coded-wire-tag release was 31.9% by Washington fisheries, with no harvest by other Pacific coast fisheries. Canadian coho fisheries were severely restricted in the late1990s.

3.4) Relationship to habitat protection and recovery strategies.

The comanagers' resource management plans for artificial production in Puget Sound are expected to be one component of a recovery plan for Puget Sound chinook under development through the Shared Strategy process. Several important analyses have been completed, including the identification of populations of Puget Sound chinook, but further development of the plan may result in an improved understanding of the habitat, harvest, and hatchery actions required for recovery of Puget Sound chinook.

3.5) Ecological interactions.

The program described in this HGMP interacts with the biotic and abiotic components of the freshwater, estuarine, and marine salmonid ecosystem through a complex web of short and longterm processes. The complexity of this web means that secondary or tertiary interactions (both positive and negative) with listed species could occur in multiple time periods, and that evaluation of the net effect can be difficult. WDFW is not aware of any studies that have directly evaluated the ecological effects of this program. Alternatively, we provide in this section a brief summary of empirical information and theoretical analyses of three types of ecological interactions, nutrient enhancement, predation, and competition, that may be relevant to this program. Recent reviews by Fresh (1997), Flagg et al. (2000), and Stockner (2003) can be consulted for additional information; NMFS (2002) provides an extensive review and application to ESA permitting of artificial production programs.

Nutrient Enhancement

Adults originating from this program that return to natural spawning areas may provide a source of nutrients in oligotrohic coastal river systems and stimulate stream productivity. Many watersheds in the Pacific Northwest appear to be nutrient-limited (Gregory et al. 1987; Kline et al. 1997) and salmonid carcasses can be an important source of marine derived nutrients (Levy 1997). Carcasses from returning adult salmon have been found to elevate stream productivity through several pathways, including: 1) the releases of nutrients from decaying carcasses has been observed to stimulate primary productivity (Wipfli et al. 1998); 2) the decaying carcasses have been found to enrich the food base of aquatic invertebrates (Mathisen et al. 1988); and 3) juvenile salmonids have been observed to feed directly on the carcasses (Bilby et al. 1996). Addition of nutrients has been observed to increase the production of salmonids (Slaney and Ward 1993; Slaney et al. 2003; Ward et al. 2003).

Predation – Freshwater Environment

Coho and steelhead released from hatchery programs may prey upon listed species of salmonids, but the magnitude of predation will depend upon the characteristic of the listed population of salmonids, the habitat in which the population occurs, and the characteristics of the hatchery program (e.g., release time, release location, number released, and size of fish released). The site specific nature of predation, and the limited number of empirical studies that have been conducted, make it difficult to predict the predation effects of any specific hatchery program. WDFW is unaware of any studies that have empirically estimated the predation risks to listed species posed by the program described in this HGMP.

In the absence of site-specific empirical information, the identification of risk factors can be a useful tool for reviewing hatchery programs while monitoring and research programs are developed and implemented. Risk factors for evaluating the potential for significant predation include the following:

<u>Environmental Characteristics.</u> Water clarity and temperature, channel size and

configuration, and river flow are among the environmental characteristics that can influence the likelihood that predation will occur (see SWIG (1984) for a review). The SIWG (1984) concluded that the potential for predation is greatest in small streams with flow and turbidity conditions conducive to high visibility.

Relative Body Size. The potential for predation is limited by the relative body size of fish released from the program and the size of prey. Generally, salmonid predators are thought to prey on fish approximately 1/3 or less their length (USFWS 1994), although coho salmon have been observed to consume juvenile chinook salmon of up to 46% of their total length (Pearsons et al. 1998). The lengths of juvenile migrant chinook salmon originating from natural production have been monitored in numerous watersheds throughout Puget Sound, including the Skagit River , Stillaguamish River, Bear Creek, Cedar River, Green River, Puyallup River, and Dungeness River. The average size of migrant chinook salmon is typically 40mm or less in February and March, but increases in the period from April through June as emergence is completed and growth commences (Table 3.5.1). Assuming that the prey item can be no greater than 1/3 the length of the predator, Table 3.5.1 can be used to determine the length of predator required to consume a chinook salmon of average length in each time period. The increasing length of natural origin juvenile chinook salmon from March through June indicates that delaying the release hatchery smolts of a fixed size will reduce the risks associated with predation.

Table 3.5.1. Average length by statistical week of natural origin juvenile chinook salmon migrants captured in traps in Puget Sound watersheds. The minimum predator length corresponding to the average length of chinook salmon migrants, assuming that the prey can be no greater than 1/3 the length of the predator, are provided in the final row of the table. (NS: not sampled.)

Watershed	Statistical Week										
	16	17	18	19	20	21	22	23	24	25	26
Skagit [1] 1997-2001	43.2	48.3	50.6	51.7	56.1	59.0	58.0	60.3	61.7	66.5	68.0
Stillaguamish [2] 2001-2002	51.4	53.5	55.7	57.8	60.0	62.1	64.2	66.4	68.5	70.6	72.8
Cedar [3] 1998-2000	54.9	64.2	66.5	70.2	75.3	77.5	80.7	85.5	89.7	99.0	113
Green [4] 2000	52.1	57.2	59.6	63.1	68.1	69.5	NS	79.0	82.4	79.4	76.3
Puyallup [5] 2002	NS	NS	NS	66.2	62.0	70.3	73.7	72.7	78.7	80.0	82.3
Dungeness [6] 1996-1997	NS	NS	NS	NS	NS	NS	NS	NS	77.9	78.8	81.8
All Systems Average Length	50.4	55.8	58.1	61.8	64.3	67.7	69.2	72.8	76.5	79.0	82.4

Minimum Predator Length	153	169	176	187	195	205	210	221	232	239	250

Sources:

[1] Data are from Seiler et al. (1998); Seiler et al. (1999); Seiler et al. (2000); Seiler et al. (2001), and Seiler et al. (2002)..

[2] Data are from regression models presented in Griffith et al. (2001) and Griffith et al. (2003).

[3] Data are from Seiler et al. (2003).

[4] Data are from Seiler et. (2002).

[5] Data are from Samarin and Sebastian (2002).

[6] Data are from Marlowe et al. (2001).

Date of Release. The release date of juvenile fish for the program can influence the likelihood that listed species are encountered or are of a size that is small enough to be consumed. The most extensive studies of the migration timing of naturally produced juvenile chinook salmon in the Puget Sound ESU have been conducted in the Skagit River, Bear Creek, Cedar River, and the Green River. Although distinct differences are evident in the timing of migration between watersheds, several general patterns are beginning to emerge:

1) Emigration occurs over a prolonged period, beginning soon after enough emergence (typically January) and continuing at least until July;
2) Two broad peaks in migration are often present during the January through July time period; an early season peak (typically in March) comprised of relatively small chinook salmon (40-45mm), and a second peak in mid-May to June comprised of larger chinook salmon;
3) On average, over 80% of the juvenile chinook have migrated past the trapping locations after statistical week 23 (usually occurring in the first week of June).

Table 3.5.2. Average cumulative proportion of the total number of natural origin juvenile chinook salmon migrants estimated to have migrated past traps in Puget Sound watersheds.

Watershed	Statistical Week										
	16	17	18	19	20	21	22	23	24	25	26
Skagit [1] 1997-2001	0.61	0.64	0.68	0.73	0.76	0.78	0.83	0.86	0.90	0.92	0.94
Bear [2] 1999-2000	0.26	0.27	0.28	0.32	0.41	0.52	0.73	0.84	0.92	0.96	0.97
Cedar [2] 1999-2000	0.76	0.76	.0.76	0.77	0.79	0.80	0.82	0.84	0.87	0.88	0.90
Green [3] 2000	0.63	0.63	0.64	0.69	0.77	0.79	0.84	0.86	0.88	0.98	1.00

All Systems Average	0.56	0.58	0.59	0.63	0.68	0.72	0.80	0.85	0.89	0.94	0.95

Sources:

[1] Data are from Seiler et al. (1998); Seiler et al. (1999); Seiler et al. (2000); Seiler et al. (2001), and Seiler et al. (2002)..

[2] Data are from Seiler et al. (2003).

[3] Data are from Seiler et. (2002).

Release Location and Release Type. The likelihood of predation may also be affected by the location and type of release. Other factors being equal, the risk of predation may increase with the length of time the fish released from the artificial production program are commingled with the listed species. In the freshwater environment, this is likely to be affected by distribution of the listed species in the watershed, the location of the release, and the speed at which fish released from the program migrate from the watershed.

Coho salmon and steelhead released from western Washington artificial production programs as smolts have typically been found to migrate rapidly downstream. Data from Seiler et al. (1997; 2000) indicate that coho smolts released from the Marblemount Hatchery on the Skagit River migrate approximately 11.2 river miles day. Steelhead smolts released onstation may travel even more rapidly – migration rates of approximately 20 river miles per day have been observed in the Cowlitz River (Harza 1998). However, trucking fish to offstation release sites, particularly release sites located outside of the watershed in which the fish have been reared, may slow migrations speeds (Table 3.5.3).

Table 3.5.3. Summary of travel speeds for steelhead smolts for several types of release strategies.

Location	Release Type	Migration Speed (river miles per day)	Source
Cowlitz River	Smolts, onstation	21.3	Harza (1998)
Kalama River	Trucked from facility located within watershed in which fish were released.	4.4	Hulett (pers. comm.)
Bingham Creek	Trucked from facility located outside of watershed in which fish were released.	0.6	Seiler et al. (1997)
Stevens Creek	Trucked from facility located outside of watershed in which fish were released.	0.5	Seiler et al. (1997)
Snow Creek	Trucked from facility located outside of watershed in which	0.4	Seiler et al. (1997)

	fish were released.		

Number Released. Increasing the number of fish released from an artificial production program may increase the risk of predation, although competition between predators for prey may eventually limit the total consumption (Peterman and Gatto 1978).

Predation – Marine Environment
WDFW is unaware of any studies that have empirically estimated the predation risks to listed species posed by the program described in this HGMP. NMFS (2002) reviewed existing information on the risks of predation in the marine environment posed by artificial production programs and concluded:

> "1) Predation by hatchery fish on natural-origin smolts or sub-adults is less likely to occur than predation on fry. Coho and chinook salmon, after entering the marine environment, generally prey upon fish one-half their length or less and consume, on average, fish prey that is less than one-fifth of their length (Brodeur 1991). During early marine life, predation on natural origin chinook, coho, and steelhead will likely be highest in situations where large, yearling-sized hatchery fish encounter sub-yearling fish or fry (SIWG 1984)."
>
> "2) However, extensive stomach content analysis of coho salmon smolts collected through several studies in marine waters of Puget Sound, Washington do not substantiate any indication of significant predation upon juvenile salmonids (Simestad and Kinney 1978)."
>
> "3) Likely reasons for apparent low predation rates on salmon juveniles, including chinook, by larger chinook and other marine predators are described by Cardwell and Fresh (1979). These reasons included: 1) due to rapid growth, fry are better able to elude predators and are accessible to a smaller proportion of predators due to size alone; 2) because fry have dispersed, they are present in low densities relative to other fish and invertebrate prey; and 3) there has either been learning or selection for some predator avoidance."

Competition
WDFW is unaware of any studies that have empirically estimated the competition risks to listed species posed by the program described in this HGMP. Studies conducted in other areas indicate that this program is likely to pose a minimal risk of competition:

> 1) As discussed above, coho salmon and steelhead released from hatchery programs as smolts typically migrate rapidly downstream. The SIWG (1984) concluded that "migrant fish will likely be present for too short a period to compete with resident salmonids."
> 2) NMFS (2002) noted that "..where interspecific populations have evolved sympatrically, chinook salmon and steelhead have evolved slight differences in

habitat use patterns that minimize their interactions with coho salmon (Nilsson 1967; Lister and Genoe 1970; Taylor 1991). Along with the habitat differences exhibited by coho and steelhead, they also show differences in foraging behavior. Peterson (1966) and Johnston (1967) reported that juvenile coho are surface oriented and feed primarily on drifting and flying insects, while steelhead are bottom oriented and feed largely on benthic invertebrates."

3) Flagg et al. (2000) concluded, "By definition, hatchery and wild salmonids will not compete unless they require the same limiting resource. Thus, the modern enhancement strategy of releasing salmon and steelhead trout as smolts markedly reduces the potential for hatchery and wild fish to compete for resources in the freshwater rearing environment. Miller (1953), Hochachka (1961), and Reimers (1963), among others, have noted that this potential for competition is further reduced by the fact that many hatchery salmonids have developed different habitat and dietary behavior than wild salmonids." Flagg et al (2000) also stated "It is unclear whether or not hatchery and wild chinook salmon utilize similar or different resources in the estuarine environment."

4) Fresh (1997) noted that "Few studies have clearly established the role of competition and predation in anadromous population declines, especially in marine habitats. A major reason for the uncertainty in the available data is the complexity and dynamic nature of competition and predation; a small change in one variable (e.g., prey size) significantly changes outcomes of competition and predation. In addition, large data gaps exist in our understanding of these interactions. For instance, evaluating the impact of introduced fishes is impossible because we do not know which nonnative fishes occur in many salmon-producing watersheds. Most available information is circumstantial. While such information can identify where inter- or intra specific relationships may occur, it does not test mechanisms explaining why observed relations exist. Thus, competition and predation are usually one of several plausible hypotheses explaining observed results."

SECTION 4. WATER SOURCE

4.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.

The water source use for fish rearing at Minter Creek Hatchery is surface water from Minter Creek. Water quality varies greatly with the time of the year and weather. Temperature profiles are monitored. Water quality is improved by the settling of solids from incoming water in the rearing ponds. There is no data on differences in water temperature between the water source and the discharging water of the ponds. The hatchery operates under NPDES permit, number WAG 13-1024. During the summer it is not always possible to meet the goals for settlelable solids from the pollution abatement pond due to the prolific growth of algae in the abatement pond.

At Coulter Creek there are two water sources; 1) a small stream that passes through the adult trap pond and 2) Coulter Creek. Coulter Creek water is pumped into two large, asphalt rearing ponds which discharge into the adult pond.

4.2) Indicate risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.

There are no native, listed, fish in either Minter Creek or Coulter Creek. Chinook are not passed upstream at Minter Creek. Hatchery-origin chinook have access to Coulter Creek. The Coulter Creek screens are .125" x .094". At Minter Creek Hatchery, there are two intake structures; a gravity intake with 1.0" x .094" screens, and a pump intake with 4.0" x .156" wedge-wire screens. Pond waste is pumped onto the wooded uplands surrounding the hatchery at Coulter Creek and into a formal abatement system at Minter Creek.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods)

Broodstock returning to Minter Creek from October to December use a concrete step ladder ending in a sorter from which species are separated into any one of 4 holding ponds or returned upstream or back downstream in some cases. All salmon are trapped during that time. All non-target species are released upstream as soon as practical.

5.2) Fish transportation equipment (description of pen, tank truck, or container used).

Fish are typically hauled in a 300 gallon steel tank. If a larger tank is needed it is borrowed from another facility.

5.3) Broodstock holding and spawning facilities.

At Minter Creek Hatchery, brood stock are held until ripe in concrete raceway-style ponds mearsuring 20' X 120'.

5.4) Incubation facilities.

All incubation is done in vertical-style incubators using either pathogen free well water or Minter Creek water.

5.5) Rearing facilities.

Fish are reared in any one of several different sized concrete raceway ponds, either 10' X

100' or more commonly in 20' X 140'.

5.6) Acclimation/release facilities.

Fish are acclimated on Minter Creek water for release into Minter Creek.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.

There have been no significant coho mortalities, but Minter Creek Hatchery uses a lot of reuse water and there is an increased risk in the spring when the rearing densities are high.

5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

The hatchery is staffed full time and have modern water alarm systems which are tested weekly.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

Describe the origin and identity of broodstock used in the program, its ESA-listing status, annual collection goals, and relationship to wild fish of the same species/population.

6.1) Source.

Broodstock source is adult coho returning to the Minter Creek Hatchery.

6.2) Supporting information.

6.2.1) History.

Minter Creek coho are a composite of various hatchery coho stocks. In the past, coho originating from Minter Creek were supplemented with coho from the Soos Creek Hatchery (Green River coho) and Marblemount Hatchery (Clarks Creek x Baker River coho). The hatchery has been self sufficient for adult return and eggs for over 25 years.

6.2.2) Annual size.

4,500 adults

6.2.3) Past and proposed level of natural fish in broodstock.

With the institution of mass marking of the 1995 brood coho, all returning adults used for broodstock will be of hatchery origin.

6.2.4) Genetic or ecological differences.

None known

6.2.5) Reasons for choosing.

Locally adapted stock.

6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.

NA

SECTION 7. BROODSTOCK COLLECTION

7.1) Life-history stage to be collected (adults, eggs, or juveniles).

Adults.

7.2) Collection or sampling design.

Coho return to Minter Creek from October to December with peak spawning taking place in mid-November. They are trapped by use of an instream barrier dam and a step ladder. At Minter, the fish enter a sorter prior to entering the holding ponds.

7.3) Identity.

All marked coho returning to the hatchery will be used for broodstock.

7.4) Proposed number to be collected:

7.4.1) Program goal (assuming 1:1 sex ratio for adults):

4,500 adults

7.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

Year	Adults Females	Males	Jacks	Eggs	Juveniles
1988					
1989					
1990					
1991					
1992					
1993					
1994					
1995	2,995	1,694	28	5,065,000	
1996	3,565	2,315	12	5,328,000	
1997	3,275	3,625	32	4,728,000	
1998	2,886	2,526	18	4,300,000	
1999	945	847	11	1,648,000	
2000	1,881	1,997	40	3,930,000	
2001	1,830	1,789	15	4,086,200	

7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.

Adults are surplused to a contract buyer and local food banks.

7.6) Fish transportation and holding methods.

Adult coho are spawned on site. There is no need to transport or inoculate adults.

7.7) Describe fish health maintenance and sanitation procedures applied.

Due to the handling and sorting of adults we have a scheduled formalin treatment for fungus control

7.8) Disposition of carcasses.

Carcasses not taken by contract buyer are buried on site.

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.

No impact on WRSC by collection of coho broodstock.

SECTION 8. MATING

Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.

8.1) Selection method.

Adults are selected throughout the entire run, at random.

8.2) Males.

Live spawning and backup males have not been used. Jacks have been used at a 2% spawner rate.

8.3) Fertilization.

Fish are spawned in five fish pools and then these gamete pools are mixed. The mixed pools are then combined into a larger container for transportation to the incubation room. All eggs are rinsed and water hardened in iodine for 1 hour.

8.4) Cryopreserved gametes.

NA

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

NA

SECTION 9. INCUBATION AND REARING -

Specify any management *goals* (e.g. "egg to smolt survival") that the hatchery is currently operating under for the hatchery stock in the appropriate sections below. Provide data on the success of meeting the desired hatchery goals.

9.1) Incubation:

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.

Green egg to eyed egg loss average 94%
Eyed egg to fry survival averages 98%

9.1.2) Cause for, and disposition of surplus egg takes.

Extra eggs/fry generally result from unanticipated program changes (co/op or educational program cancellations). We try to use the extra eggs/fry to meet shortages within the fish health zone or, as a last resort, they are planted into a local lake without an outlet.

9.1.3) Loading densities applied during incubation.

Eggs generally run about 2000 per pound and they are loaded at 9000 eggs/tray. Flows are 4 gallons per minute (gpm) for a 8 tray half-stack.

9.1.4) Incubation conditions.

At Minter Creek the silt loads in the incubators are monitored and the incubators are cleaned as needed. Most incubation is done with well water which is a constant 49 degrees Fahrenheit. Some surface water is used to control softshell disease which is exacerbated by incubation solely on well water. Surface water is also used in cases where the well water demands exceed output capacity.

9.1.5) Ponding.

Fry are usually force ponded in January based on visual inspection of the fish. It is difficult to monitor accurate temperature units to determine when to pond fry as they are sometimes on well water and sometimes on creek water when well water demand exceeds supply.

9.1.6) Fish health maintenance and monitoring.

Fungus is controlled with a formalin drip treatment. Egg mortality is removed using a mechanical picker when eggs reach the eyed stage. For soft shell control, some surface water is used during incubation, either mixed with well water, or in alternate time periods of well then surface water. It is believed that there are beneficial surface water bacteria which preclude soft shell from occurring when eggs are returned to incubation on well water. Also, see section 9.1.4

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.

NA

9.2) <u>Rearing</u>:

9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available..

Green egg to eyed survival averages 94% (See sections 9.1.4 and 9.1.6)
Eyed egg to fry survival averages 98%
Ponded fry to smolt release survival averages 97%

Note: Covering all ponds with bird predator netting has increased fry to smolt survivals by 5 to 10% over pre-coverage survivals.

9.2.2) Density and loading criteria (goals and actual levels).

Current loadings for yearlings and zero's:

Zero's: 2.0 pounds (lbs)/gpm Flow Index .86 Density Index .11 Exchange Rate 58 min
Yearlings: 11.7 lbs/gpm Flow Index 2.1 Density Index .23 Exchange Rate 68 min

9.2.3) Fish rearing conditions

Ponds are monitored for temperature, flows and dissolved oxygen levels.

9.2.4) Indicate biweekly or monthly fish growth information (*average program performance*), including length, weight, and condition factor data collected during rearing, if available.

Not available

9.2.5) Indicate monthly fish growth rate and energy reserve data (*average program performance*), if available.

Not available

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency

during rearing (*average program performance*).

Feed Type: Bio-Moist Starter, Bio-Moist Grower and Moore-Clark Fry
Feed Rate: Range from 2.5% B.W./day down to .75%, try to not exceed .10lbs/ gpm
Food Conversion: 1.1 to 1

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.

Fish health is monitored by staff and a fish health specialist. Treatments are prescribed by the fish health specialist. Ponds are cleaned weekly.

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.

NA

9.2.9) Indicate the use of "natural" rearing methods as applied in the program.

NA

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.

NA

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

10.1) Proposed fish release levels.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs				
Unfed Fry				
Fry				
Fingerling				
Yearling	1,044,000	17	April-May	Minter Creek

Additionally:

1) 1,200,000 egg are transferred to the Nisqually tribal hatchery at Clear Creek for rearing and release.

2) 600,000 are transferred to the Agate Pass Sea Pens (Suquamish tribe) via Coulter Creek for rearing and release.

3) The hatchery also transfers eggs to schools and eggs to Regional Enhancement Groups and other co-ops for releases into various streams in South Puget Sound.

10.2) Specific location(s) of proposed release(s).

Stream, river, or watercourse: Minter Creek (15.0048)
Release point: Minter Creek (RM 0.5)
Major watershed: Minter Creek (15.0048), Carr Inlet
Basin or Region: Puget Sound

10.3) Actual numbers and sizes of fish released by age class through the program.

Release year	Eggs/ Unfed Fry	Avg size	Fry	Avg size	Fingerling	Avg size	Yearling	Avg size
1988								
1989								
1990								
1991								
1992								
1993								
1994								
1995			1,127,070	450	107,382	100	645,000	17
1996	216,000	1450	1,001,484	450			1,468,400	18
1997	129,000	1600	996,444	500	356,200	115	1,379,433	18
1998	277,000	1600	1,000,000	422	319,500	75	1,338,485	17
1999	8,000	1600	187,900	398			1,468,000	18
2000			2,091,000	500			1,508,400	17
2001					245,000	116	948,350	20
Average	157,500	1,563	1,067,316	453	257,021	102	1,250,867	18

10.4) Actual dates of release and description of release protocols.

Fish are released between mid-April and late May. The release time varies and is determined by (low) creek flows and dissolved oxygen levels in the ponds. Due to the location of the facility (upper end of a tidal estuary) fish are released at night on an incoming tide to minimize predation. In most cases the fish are forced out.

10.5) Fish transportation procedures, if applicable.

Fish are released on station.

10.6) Acclimation procedures.

Reared on ambient surface water.

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

All coho released from the facility are 100% adipose-fin clipped.

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

Any surpluses are identified in the fry stage when the fish are clipped and excess are disposed of at that time as stated in section 9.1.2. Release ponds are loaded at program levels at that time.

10.9) Fish health certification procedures applied pre-release.

Each lot of fish is examined by a WDFW Fish Health Specialist prior to release or transfer in accordance with the Co-Managers Salmonid Disease Policy.

10.10) Emergency release procedures in response to flooding or water system failure.

In the event of a water system failure, screens would be pulled to allow fish to exit the pond. In some cases they can be transferred into other rearing vessels to prevent an emergency release.

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

Coho are released from Minter Creek Hatchery as yearling smolts end of April to late May at night. With the distance between the facility and the estuary very short (0.5 RM) releasing yearling smolts speeds migration time to salt water and thus reduce the likelihood of hatchery fish preying on or competing with wild salmonids. And releasing them at night minimizes any interaction with listed fish. The Puget Sound Technical Recovery Team has not identified Minter Creek as a historical chinook salmon population.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

11.1) Monitoring and evaluation of "Performance Indicators" presented in Section 1.10.

11.1.1) Describe plans and methods proposed to collect data necessary to respond to each "Performance Indicator" identified for the program.

The comanagers conduct numerous ongoing monitor programs, including catch, escapement, marking, tagging, and fish health testing. The focus of enhanced monitoring and evaluation programs will be on the risks posed by ecological interactions with listed species. WDFW is proceeding on four tracks:

1) An ongoing research program conducted by Duffy et al. (2002) is assessing the nearshore distribution, size structure, and trophic interactions of juvenile salmon, and potential predators and competitors, in northern and southern Puget Sound. Funding is provided through the federal Hatchery Scientific Review Group.

2) A three year study of the estuarine and early marine use of Sinclair Inlet by juvenile salmonids is nearing completion. The project has four objectives:

a) Assess the spatial and temporal use of littoral habitats by juvenile chinook throughout the time these fish are available in the inlet;

b) Assess the use of offshore (i.e., non-littoral) habitats by juvenile chinook;

c) Determine how long cohorts of juvenile chinook salmon are present in Sinclair inlet;

d) Examine the trophic ecology of juvenile chinook in Sinclair Inlet. This will consist of evaluating the diets of wild chinook salmon and some of their potential predators and competitors.

Funding is provided by the USDD-Navy.

3) WDFW is developing the design for a research project to assess the risks of predation on listed species by coho salmon and steelhead released from artificial production programs. Questions which this project will address include:

a) How does trucking and the source of fish (within watershed or out of watershed) affect the migration rate of juvenile steelhead?

b) How many juvenile chinook salmon of natural origin do coho salmon and steelhead consume?

c) What is the rate of residualism of steelhead in Puget Sound rivers?

Funding needs have not yet been quanitifed, but would likely be met through a combination of federal and state sources.

4) WDFW is assisting the Hatchery Scientific Review Group in the development of a template for a regional monitoring plan. The template will provide an integrated assessment of hatchery and wild populations.

11.1.2) Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.

See Section 11.1.1.

11.2) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.

Risk aversion measures will be developed in conjunction with the monitoring and evaluation plans.

SECTION 12. RESEARCH

12.1) Objective or purpose.

Entities managing fishery resources in the Pacific Northwest are struggling with an intriguing paradox related to the use of fish culture to aid in recovery of depressed populations. Hatcheries are seen as a likely tool contributing to recovery efforts yet domesticated hatchery salmonids typically exhibit low reproductive success in natural habitats and thus likely pose genetic and ecological risks to extant native populations (Leider et al. 1990, Hinder et al. 1991, Fleming et al. 1996, Reisenbichler and Ruben, 1999). A need exists to directly evaluate the effects of domestication on natural reproductive fitness and, perhaps equally important, to determine how quickly renaturalization of hatchery-origin fish might be expected to reduce differences in fitness between hatchery and wild fish over time. To that end, this research proposes to directly examine these two issues using coho salmon in a natural stream (Minter Creek, a representative salmon-bearing tributary to Puget Sound). Also proposed is to perform some specific experiments in an artificial stream setting in order to gain a better understanding of the biological basis of any observed differences between hatchery and wild-origin fish. Contemporary DNA-based genetic tools are proposed to be used in combination with morphological and behavioral analyses to: 1) measure (and identify causal factors for) differences in natural reproductive competence between wild and hatchery coho salmon, and 2) explore the relationship between reproductive fitness in the natural environment and degree of hatchery ancestry. Tissue samples will be taken from adult coho salmon passed upstream (2000, 2001, 2003) and from their progeny (2001-2005) during the fry and smolt stages. Progeny will be collected by smolt trap (2002-2005) and seining/electro fishing (2001-2004). Limited encounters with listed White River spring chinook juveniles will occur.

12.2) Cooperating and funding agencies.

National Marine Fisheries Service (NMFS)

12.3) Principle investigator or project supervisor and staff.

Howard Fuss, WDFW
Mike Ford, NMFS

12.4) Status of stock, particularly the group affected by project, if different than the stock(s) described in Section 2.

Hatchery reared White River spring chinook

12.5) Techniques: include capture methods, drugs, samples collected, tags applied.

Spring chinook will be captured incidentally to sampling of coho fry by seine or electro fishing. We anticipate no handling of spring chinook in smolt trap due to its' location upstream of the hatchery release point.

12.6) Dates or time period in which research activity occurs.

Research will be each year (2001-2004) from March 1 until July 1.

12.7) Care and maintenance of live fish or eggs, holding duration, transport methods.

White River spring chinook will be released without further handling. Coho will be held and anesthetized according to standard protocols to assure safe release.

12.8) Expected type and effects of take and potential for injury or mortality.

We expect less than 1% mortality on the fish collected for measurement.

12.9) Level of take of listed fish: number or range of fish handled, injured, or killed by sex, age, or size, if not already indicated in Section 2 and the attached "take table" (Table 1).

We expect to encounter fewer than 50 residual White River spring chinook in Minter Creek during seining or electro fishing of coho. Most of our effort will occur above the release point of the hatchery chinook.

12.10) Alternative methods to achieve project objectives.

None. Smolt trapping and coho fry collection is one element of the Minter Creek Coho Genetics Study funded under the Hatchery Scientific Review Group (HSRG).

12.11) List species similar or related to the threatened species; provide number and causes of mortality related to this research project.

We expect to encounter chinook (<50), cutthroat (>50), coho (>500) and chum (<500).

12.12) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse ecological effects, injury, or mortality to listed fish as a result of the proposed research activities.

White River spring chinook captured incidentally will be released immediately. Most of the effort will occur above the release point of the hatchery chinook.

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the foregoing information is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973."

Name, Title, and Signature of Applicant:

Certified by_______________________________ Date:______________

Table 1. Estimated listed salmonid take levels of by hatchery activity.

Listed species affected: Chinook ESU/Population: Puget Sound Chinook Activity: Hatchery Operations				
Location of hatchery activity: Minter Creek_ Dates of activity: October-June Hatchery program operator: WDFW				
Type of Take	Annual Take of Listed Fish By Life Stage *(<u>Number of Fish</u>)*			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)			Unknown	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)		Unknown	Unknown	
Other Take (specify) h)				

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.
b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
e. Listed fish removed from the wild and collected for use as broodstock.
f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
h. Other takes not identified above as a category.

Table 1. Estimated listed salmonid take levels of by hatchery activity.

Listed species affected: Chinook ESU/Population: Puget Sound Chinook Activity: Research				
Location of hatchery activity: Minter Creek Dates of activity: October-July Hatchery program operator: WDFW				
Type of Take	**Annual Take of Listed Fish By Life Stage *(Number of Fish)***			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)		<50*		
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)		<1%*		
Other Take (specify) h)				

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.

b. Take associated with weir or trapping operations where listed fish are captured and transported for release.

c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.

d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.

e. Listed fish removed from the wild and collected for use as broodstock.

f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.

g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.

h. Other takes not identified above as a category.

*-Refer to section 12 (Research).